

### Amendments to the Claims:

This listing of claim will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) ~~In a~~ spread spectrum communication system of the type that processes one or more spread-spectrum waveforms (“user spread-spectrum waveforms”), each representative of a waveform associated with a respective user, ~~the improvement~~ comprising:

a first logic element that generates a residual composite spread-spectrum waveform as a function of an arithmetic difference between a composite spread-spectrum waveform and an estimated composite spread-spectrum waveform,

one or more second logic elements each coupled to the first logic element, each second logic element generating a refined matched-filter detection statistic for at least a selected user as a function of

- (i) the residual composite spread-spectrum waveform and
  - (ii) a characteristic of an estimate of the selected user’s spread-spectrum waveform.
2. (Currently Amended) ~~In t~~The system of claim 1, ~~the further improvement~~ wherein the characteristic is at least one of an estimated amplitude and an estimated symbol associated with the estimate of the selected user’s spread-spectrum waveform.
3. (Currently Amended) ~~In t~~The system of claim 1, ~~the improvement~~ wherein the spread-spectrum communications system comprises a code division multiple access (CDMA) base station.
4. (Currently Amended) ~~In t~~The system of claim 1, ~~the improvement~~ wherein the CDMA base station comprises one or more long-code receivers, and each long-code receiver generating one or more respective matched-filter detection statistics, from which the estimated composite spread-spectrum waveform is, in part, generated.

5. (Currently Amended) In ~~the~~the system of claim 1, ~~the improvement~~ wherein the first logic element comprises summation logic which generates the residual composite spread-spectrum waveform based on the relation

$$r_{res}^{(n)}[t] \equiv r[t] - \hat{r}^{(n)}[t],$$

wherein

$r_{res}^{(n)}[t]$  is the residual composite spread-spectrum waveform,

$r[t]$  represents the composite spread-spectrum waveform,

$\hat{r}^{(n)}[t]$  represents the estimated composite spread-spectrum waveform,

$t$  is a sample time period, and

$n$  is an iteration count.

6. (Currently Amended) In ~~the~~the system of claim 5, ~~the further improvement~~ wherein the estimated composite spread-spectrum waveform is pulse-shaped and is based on estimated complex amplitudes, estimated delay lags, estimated symbols, and codes of the one or more user spread-spectrum waveforms.

7. (Currently Amended) In ~~the~~the system of claim 1, ~~the further improvement~~ wherein each second logic element comprises rake logic and summation logic which generates the refined matched-filter detection statistics based on the relation

$$y_k^{(n+1)}[m] = A_k^{(n)^2} \cdot \hat{b}_k^{(n)}[m] + y_{res,k}^{(n)}[m]$$

wherein

$A_k^{(n)^2}$  represents an amplitude statistic,

$\hat{b}_k^{(n)}[m]$  represents a soft symbol estimate for the  $k^{\text{th}}$  user for the  $m^{\text{th}}$  symbol period ,

$y_{res,k}^{(n)}[m]$  represents a residual matched-filter detection statistic for the  $k^{\text{th}}$  user,  
and

$n$  is an iteration count.

8. (Currently Amended) ~~In the~~ The system of claim 1, ~~the further improvement~~ wherein the refined matched-filter detection statistic for each user is iteratively generated.
9. (Currently Amended) ~~In the~~ The system of claim 1, ~~the further improvement~~ wherein the refined matched-filter detection statistic for at least a selected user is generated by a long-code receiver.
10. (Currently Amended) ~~In the~~ The system of claim 1, ~~the improvement~~ wherein the first and second logic elements are implemented on any of processors, field programmable gate arrays, array processors and co-processors, or any combination thereof.

11. (Currently Amended) ~~In a~~ A spread spectrum communication system of the type that processes one or more user spread-spectrum waveforms, each representative of a waveform associated with a respective user, ~~the improvement~~ comprising:

a first logic element which generates an estimated composite spread-spectrum waveform that is a function of estimated user complex channel amplitudes, time lags, and user codes,

a second logic element coupled to the first logic element, the second logic element generating a residual composite spread-spectrum waveform as a function of an arithmetic difference between a composite user spread-spectrum waveform and the estimated composite spread-spectrum waveform,

one or more third logic elements each coupled to the second logic element, the third logic element generating a refined matched-filter detection statistic for at least a selected user as a function of

- (i) the residual composite spread-spectrum waveform and
- (ii) a characteristic of an estimate of the selected user's spread-spectrum waveform.

12. (Currently Amended) ~~In the~~ The system of claim 11, ~~the further improvement~~ wherein the characteristic is at least one of an estimated amplitude, an estimated delay lag and an

estimated symbol associated with the estimate of the selected user's spread-spectrum waveform.

13. (Currently Amended) ~~In the~~ The system of claim 11, ~~the improvement~~ wherein the spread-spectrum communications system is a code division multiple access (CDMA) base station.
14. (Currently Amended) ~~In the~~ The system of claim 13, ~~the improvement~~ wherein the CDMA base station comprises long-code receivers.
15. (Currently Amended) ~~In the~~ The system of claim 11, ~~the improvement~~ wherein the first logic element further comprises arithmetic logic which generates the estimated composite spread-spectrum waveform based on the relation

$$\hat{p}^{(n)}[t] = \sum_r g[r] \rho^{(n)}[t-r],$$

wherein

$\hat{p}^{(n)}[t]$  represents the estimated composite spread-spectrum waveform,

$\rho^{(n)}[t-r]$  represents an estimated composite re-spread waveform,

$g[r]$  represents a raised-cosine pulse shape.

16. (Currently Amended) ~~In the~~ The system of claim 15, ~~the further improvement~~ wherein the first logic element comprises arithmetic logic which generates an estimated composite re-spread waveform based on the relation

$$\rho^{(n)}[t] = \sum_{k=1}^{K_v} \sum_{p=1}^L \sum_r \delta[t - \hat{\tau}_{kp}^{(n)} - rN_c] \cdot \hat{a}_{kp}^{(n)} \cdot c_k[r] \cdot \hat{b}_k^{(n)}[\lfloor r / N_k \rfloor],$$

wherein

$K_v$  is a number of simultaneous dedicated physical channels for all users,

$\delta[t]$  is a discrete-time delta function,

$\hat{\alpha}_{kp}^{(n)}$  is an estimated complex channel amplitude for the  $p^{\text{th}}$  multipath component for the  $k^{\text{th}}$  user,

$c_k[r]$  represents a user code comprising at least a scrambling code, an orthogonal variable spreading factor code, and a  $j$  factor associated with even numbered dedicated physical channels,

$\hat{b}_k^{(n)}[m]$  represents a soft symbol estimate for the  $k^{\text{th}}$  user for the  $m^{\text{th}}$  symbol period,

$\hat{\tau}_{kp}^{(n)}$  is an estimated time lag for the  $p^{\text{th}}$  multipath component for the  $k^{\text{th}}$  user ,

$N_k$  is a spreading factor for the  $k^{\text{th}}$  user,

$t$  is a sample time index,

$L$  is a number of multi-path components.,

$N_c$  is a number of samples per chip, and

$n$  is an iteration count.

17. (Currently Amended) In the system of claim 11, the improvement wherein the second logic element comprises summation logic which generates the residual composite spread-spectrum waveform that based on the relation

$$r_{res}^{(n)}[t] \equiv r[t] - \hat{r}^{(n)}[t],$$

wherein

$r_{res}^{(n)}[t]$  is the residual composite spread-spectrum waveform ,

$r[t]$  represents the composite spread-spectrum waveform,

$\hat{r}^{(n)}[t]$  represents the estimated composite spread-spectrum waveform,

$t$  is a sample time period, and

$n$  is an iteration count.

18. (Currently Amended) ~~In the~~ The system of claim 17, ~~the further improvement~~ wherein the estimated composite spread-spectrum waveform is pulse-shaped and is based on the user spread-spectrum waveform.
19. (Currently Amended) ~~In the~~ The system of claim 18, ~~the further improvement~~ wherein each third logic element comprises rake logic and summation logic which generates the second user matched-filter detection statistic based on the relation

$$y_k^{(n+1)}[m] = A_k^{(n)^2} \cdot \hat{b}_k^{(n)}[m] + y_{res,k}^{(n)}[m],$$

wherein

$A_k^{(n)^2}$  represents an amplitude statistic,

$\hat{b}_k^{(n)}[m]$  represents a soft symbol estimate for the  $k^{\text{th}}$  user for the  $m^{\text{th}}$  symbol period,

$y_{res,k}^{(n)}[m]$  represents the user residual matched-filter detection statistic for the  $m^{\text{th}}$  symbol period, and

$n$  is an iteration count.

20. (Currently Amended) ~~In the~~ The system of claim 11, ~~the further improvement~~ wherein the refined matched-filter detection statistic for each user is iteratively generated.
21. (Currently Amended) ~~In the~~ The system of claim 11, ~~the improvement~~ wherein the logic elements are implemented on any of a processors, field programmable gate arrays, array processors and co-processors, or any combination thereof.
22. (Currently Amended) A method for multiple user detection in a spread-spectrum communication system that processes long-code spread-spectrum user transmitted waveforms comprising:

generating a residual composite spread-spectrum waveform as a function of an arithmetic difference between a composite spread-spectrum waveform and an estimated composite spread-spectrum waveform,

generating a refined matched-filter detection statistic that is a function of a sum of a rake-processed residual composite spread-spectrum waveform for a selected user and an amplitude statistic for that selected user.

23. (Original) The method of claim 22, comprising generating a refined matched-filter detection statistic that is a function of a sum of a rake-processed residual composite spread-spectrum waveform for a selected user and an amplitude statistic for that selected user multiplied by a soft symbol estimate.
24. (Original) The method of claim 22, further wherein the spread-spectrum communications system is a code division multiple access (CDMA) base station.
25. (Original) The method of claim 22, wherein the step of generating the residual composite spread-spectrum waveform further comprises performing arithmetic logic that is based on the relation

$$r_{res}^{(n)}[t] \equiv r[t] - \hat{r}^{(n)}[t],$$

wherein

$r_{res}^{(n)}[t]$  is the residual composite spread-spectrum waveform ,

$r[t]$  represents the composite spread-spectrum waveform,

$\hat{r}^{(n)}[t]$  represents the estimated composite spread-spectrum waveform,

$t$  is a sample time period, and

$n$  is an iteration count.

26. (Original) The method of claim 22, wherein the estimated composite spread-spectrum waveform is pulse-shaped and is based on a composite user re-spread waveform.

27. (Original) The method of claim 22, wherein the step of generating the refined matched-filter detection statistic representative of that user further comprises performing arithmetic logic based on the relation

$$y_k^{(n+1)}[m] = A_k^{(n)^2} \cdot \hat{b}_k^{(n)}[m] + y_{res,k}^{(n)}[m]$$

wherein

$A_k^{(n)^2}$  represents an amplitude statistic,

$\hat{b}_k^{(n)}[m]$  represents a soft symbol estimate for the  $k^{\text{th}}$  user for the  $m^{\text{th}}$  symbol period,

$y_{res,k}^{(n)}[m]$  represents a residual matched-filter detection statistic, and

$n$  is an iteration count.

28. (Original) The method of claim 22, the further improvement wherein the refined matched-filter detection statistic is generated by a long-code receiver.
29. (Currently Amended) The method of claim 22, the further improvement wherein the step of generating the residual matched-filter detection statistic for an  $m^{\text{th}}$  symbol period comprises performing arithmetic logic based on the relation

$$y_{res,k}^{(n)}[m] \equiv \text{Re} \left\{ \sum_{p=1}^L \hat{a}_{kp}^{(n)H} \cdot \frac{1}{2N_k} \sum_{r=0}^{N_k-1} r_{res}^{(n)}[rN_c + \hat{\tau}_{kp}^{(n)} + mT_k] \cdot c_{km}^*[r] \right\}$$

wherein

$y_{res,k}^{(n)}[m]$  represents the user residual matched-filter detection statistic for the  $m^{\text{th}}$  symbol period,

$L$  is a number of multi-path components,

$\hat{a}_{kp}^{(n)}$   $\underline{\hat{a}}_{kp}^{(n)H}$  is the estimated complex channel amplitude for the  $p^{\text{th}}$  multipath component for the  $k^{\text{th}}$  user,

$N_k$  is the spreading factor for the  $k^{\text{th}}$  user,



$r_{res}^{(n)}[t]$  is the residual composite spread-spectrum waveform ,

$N_c$  is the number of samples per chip, and

$\hat{\tau}_{kp}^{(n)}$  is the time lag for the  $p^{\text{th}}$  multipath component for the  $k^{\text{th}}$  user ,

$m$  is a symbol period,

$T_k$  is a channel symbol duration for the  $k^{\text{th}}$  user,

$c_{km}[r]$  c \* km[r] represents a user code comprising at least a scrambling code,  
an orthogonal variable spreading factor code, and a  $j$  factor  
associated with even numbered dedicated physical channels.

$n$  is an iteration count.